Nuclear Science Division Newsletter

In this issue: **October, 2011**

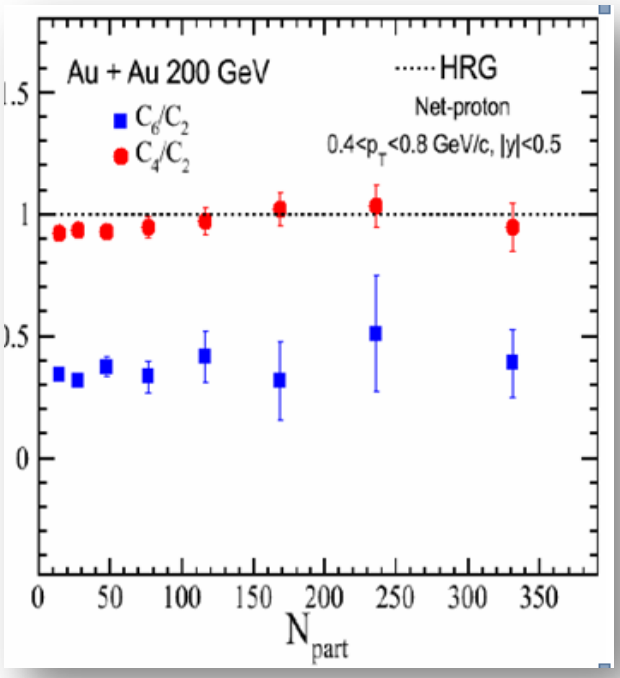
Le Cirque de Physique Nucleaire

LBNL welcomed the local community to its quasi-annual Open House – "Le Cirque des Sciences," on October 15th. About 4500 Bay Area residents took advantage of the opportunity to learn about what we do here. The Nuclear Science Division was well represented, with exhibits on radiation detection, the sophisticated engineering inherent in the STAR Heavy Flavor Tracker, GRETINA and SNO, and a booth focused on IceCube.

Boxing in the QCD Phase Diagram

An Oct. 3-5 RBRC workshop at Brookhaven National Laboratory examined the status of the search for a QCD critical point and phase coexistence region. Both STAR and PHENIX presented new results from the beam energy scan, including data on the excitation function of azimuthal asymmetries and measurements of higher order cumulants of the net-proton distribution.

The azimuthal asymmetries measured by both PHENIX and STAR at a center of mass energy of 39 AGeV are virtually unchanged from the top RHIC and LHC energies, indicating that the transport properties change little above this energy. Thus a phase change, if present, is most likely located below 39 AGeV.



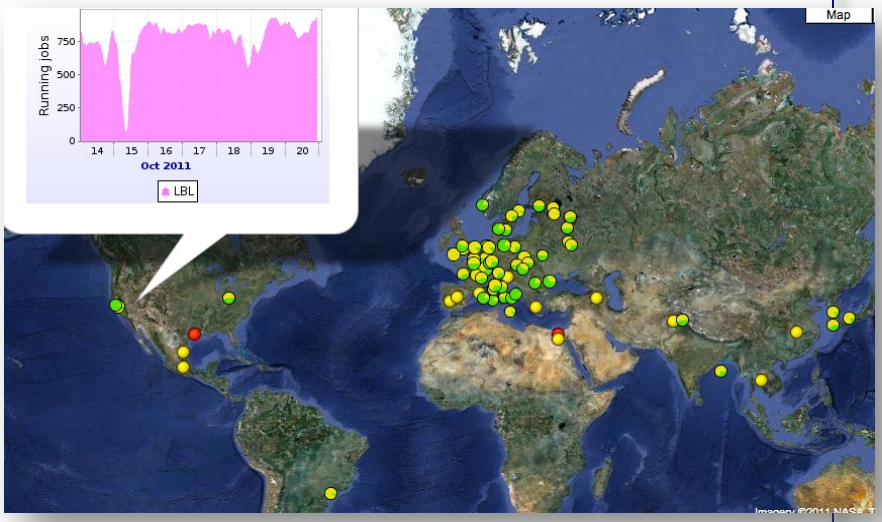
STAR data showing the skewness and kurtosis of the net-proton distribution, as a function of the number of participants in the collision (higher is a more central collision).

The STAR collaboration has made progress in measuring higher order cumulants of the net proton-distribution. These cumulants probe the shape of the event-by-event net proton distribution. At energies below 39 GeV, both the skewness and kurtosis (4th and 6th order cumulants) deviate from hadron gas model predictions. Remarkably, the ratio of the sixth order over the fourth order cumulant shown in the figure is less than one even at top RHIC energies. This qualitatively agrees with Lattice QCD calculations, which predict a similar behavior. Although the lattice calculations of the QCD energy density at the hadronization temperature agree with the hadron gas model, the higher order derivatives level off with increasing temperature, leading to smaller cumulants.

Has STAR definitively established the expected deviation from the hadron gas? Not yet! First we need to understand the rather constant centrality dependence. Then, one would like to see a similar behavior in the cumulants of the energy distribution. Still, this is a big step forward.

Alice computing gets examined

The ALICE experiment at the CERN Large Hadron Collider (LHC) is dedicated to the study of high energy nuclear collisions that replicate the conditions of the early universe, 10 microseconds after the Big Bang. The LHC has been running for two years, during which time ALICE has collected an enormous amount of data from both proton-proton and heavy ion collisions. Analysis of these data requires a coordinated, world-wide effort linking computer centers in many countries. ALICE data analysis in the US is concentrated at two centers, NERSC at LBNL and the Livermore Computing Center at LLNL, with LBNL the Computing Project Host Laboratory. The ALICE contribution to these facilities is funded by the DOE, with the scope of the contributions governed by an MOU agreement between CERN and LBNL. In LHC computing terms, the two facilities jointly form an "ALICE Grid Tier 2" Center.



The ALICE-USA Project Plan requires a bi-annual review, called by the ALICE-USA Coordinator. The first such review was held at LBNL on October 5, 2011, with a review committee consisting of Michael Ernst (BNL, head of RHIC/ATLAS Computing Facility), Ian Fisk (FNAL, CMS-USA Computing Coordinator), and Kent Blackburn (CalTech, LIGO). Representatives from the Nuclear Physics Office of DOE were present as observers. The committee was charged to evaluate the current state of the project in terms of requirements, performance and staffing, as well as the feasibility to meet its future goals.

The review was spirited and productive. The reviewers provided very useful feedback to the project, including recommendations for revisions of the ALICE-USA Computing Project plan, re-evaluation of algorithms for ALICE data distribution to the two ALICE-USA sites, and considerations for overall ALICE deployment of disk capacities relative to real utilization. The committee saw no strong benefit to LLNL/LBNL evolving into an ALICE Tier 1 facility, which had been under discussion at past reviews. The executive summary of the report concludes:

"Overall, the presenters provided impressive evidence of progress, and the committee praised the advances made since the project received funds in FY 2010. As of today both participating sites have demonstrated their outstanding ability to reliably contribute to ALICE's managed production and user analysis activities at excellent performance."

NSD Fragments

Division Director **James Symons** has been appointed as LBNL Associate Laboratory Director, in addition to his divisional responsibilities. As ALD for General Sciences, Symons will champion the Lab's highly-accomplished research divisions in accelerator and fusion research, engineering, nuclear science, and physics.

An NSD/Engineering Team has won a LBNL outstanding performance award for completing GRETINA on cost and on budget. At right, NSD Director James Symons and Engineering Division Kem Robinson are shown presenting the award to the team of physicists, electrical and mechanical engineers at a NSD Monday Morning Meeting. GRETINAs first science runs have begun and we are looking forward to the first results.

Shown are *(Left to Right)* Kem Robinson, **Steve Virostek** (Mech. Eng), **Tim Loew** (Mech. Eng.), **Denis Peterson** (Controls), **Thorsten Stezelberger** (Elec. Eng.), **Chris Campbell** (NSD), **I-Yang Lee** (NSD), **Mario Cromaz** (NSD), John Garcia (Eng.), **Carl Lionberger** (DAQ Eng.), **Joe Wallig** (Eng.) and James Symons. Not shown are **Augusto Macchiavelli** (NSD, on night shift), **Sergio Zimmerman**, **Dionisio Doering** (Eng.) and **Stefanos Paschalis** (Eng.).

Three graduate students *(right)* from Karlsruhe Institute of Technology (KIT) in Germany are spending the next four months with the KATRIN group in NSD, Two PhD students, **Marco Haag** *(center)* and **Markus Hoetzel** *(right),* are supported by the Karlsruhe House of Young Scientists fellowship, while Diploma student **Sebastian Schams** *(left)* is supported by a DAAD fellowship.

The Heavy Element Physics and Chemistry group welcome two new graduate students. UC Berkeley students **Adam Rice** and **Phillip Mudder** will work with Prof. Heino Nitsche.

Previous issues of the newsletter are available at:
https://commons.lbl.gov/display/nsd/NSD+Newsletter